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National NIF Diagnostic Program Fiscal Year 2002 Third Quarter Report

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U.S. Department of Energy

Lawrence Livermore National Laboratory

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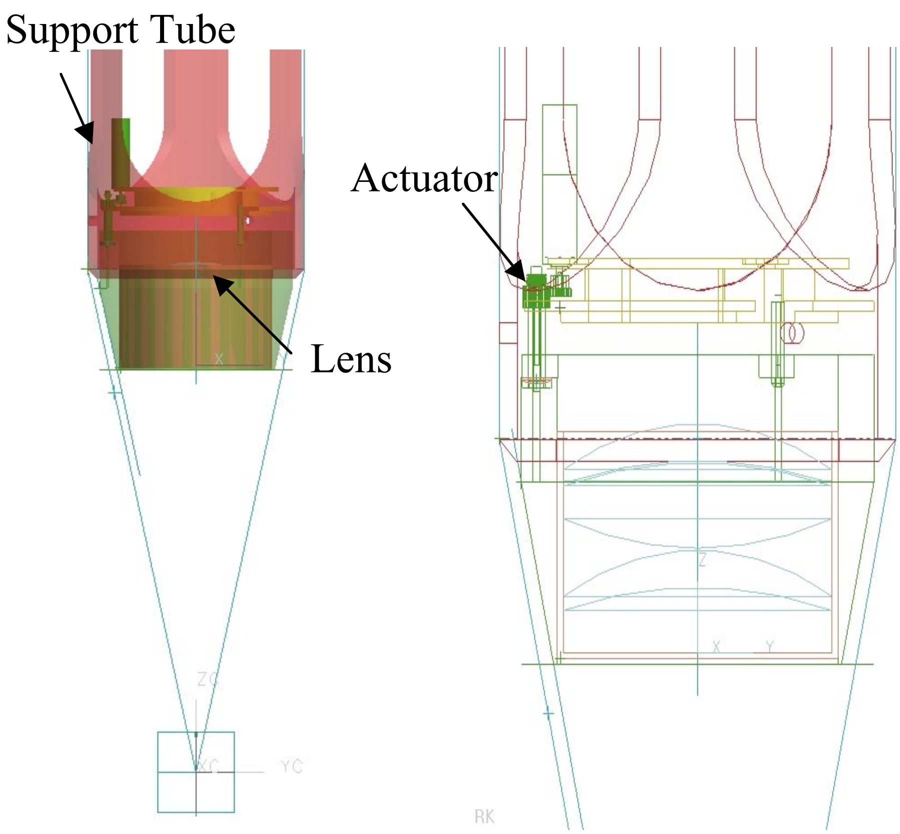
National NIF Diagnostic Program
Fiscal Year 2002 Third Quarter Report



Conceptual design layout of VISAR collection optic

July 2002

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NATIONAL IGNITION FACILITY

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National NIF Diagnostics Program
FY02 Third Quarter Report
July 2002

Overview and Summary

Since October 2001, the development of the facility diagnostics for NIF has been funded by the NIF Director through the National NIF Diagnostic Program (NNDP). The current emphasis of the NNDP is on diagnostics for the early NIF quad scheduled to be available for experiment commissioning in FY03. During the past nine months, the NNDP has set in place processes for funding diagnostics, developing requirements for diagnostics, design reviews, and monthly status reporting. Work has been funded at Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory (LANL), the Naval Research Laboratory (NRL), Sandia National Laboratories (SNL), and Bechtal Nevada at Los Alamos and Santa Barbara. There are no major technical risks with the early diagnostics. The main concerns relate to integration of the diagnostics into the facility; all such issues are being worked. This report is organized to show the schedule and budget status and a summary of Change Control Board actions for the past three months. The following sections then provide short descriptions of the status of each diagnostic. Where design reviews or requirements documents are cited, the documents are available on the Diagnostics file server or on request.

Schedule Report

Table 1 summarizes the Level 3 milestones met in the last quarter together with projected completion of outstanding milestones. The plan date refers to the target date in the Control Account Plan for each diagnostic. Although some near-term milestones have slipped relative to plan (e.g., for Static X-ray Imager [SXI]), final delivery dates of the diagnostics are still consistent with the NIF first quad schedule. The slippage has been mainly in completing design reviews and finalizing diagnostic requirements for the neutron yield diagnostic. The SXI delivery has been delayed by fabrication problems at the vendor. The M6 dates (shown in yellow) correspond to the first date that the diagnostic or manipulator will be available for use on NIF for either laser commissioning or experiment commissioning. In general, the final delivery date is being maintained; however, the Streaked X-ray Detector (SXD) delivery dates have been delayed slightly through a Budget/Schedule Change Request (BSCR) action. This step was taken to make the schedule consistent with the delay in delivery of the first instrument from the vendor. That delay was occasioned by a combination of the need to reduce budget outlay for the NIF Director in FY02 and the need to spend more time completing tests at the vendor.

This quarter saw Conceptual Design Reviews (CDRs) for two instruments being developed by teams in Los Alamos, NM. One team from Bechtel Nevada at Los Alamos is designing the VISAR interferometer for use on early equation of state experiments. The other team at LANL is developing the Gated X-ray Detector (GXD) for use in a wide variety of experiments including hydrodynamics instability experiments. The next quarter should see good progress on the VISAR and GXD designs through their 65% reviews, completion of the SXI fabrication, delivery of the second Diagnostics Instrument Manipulator (DIM) and agreement on the neutron yield diagnostic requirements, allowing work on that device to accelerate.

Table 1. Level 3 milestones met this quarter and projected completions for the facility diagnostics.

Diagnostic	Deliverable(ompleted)	level	Plan Date	Projected/ actual completion
GXD	Conceptual design review complete	3	Apr-02	Apr-02
SXD	100% design review complete	3	Mar-02	May-02
VISAR	Conceptual design review complete	3	Jun-02	Jun-02
VISAR	65% design review complete	3	Aug-02	Aug-02
NY	Requirements Review complete	3	Apr-02	Aug-02
SXI	SXI-1 Fab & Assembly Complete	3	May-02	Sep-02
DIM	2nd DIM Fabrication & Assembly (M4A)	3	Sep-02	Sep-02
GXD	65% design review complete	3	Sep-02	Sep-02
SXD	First streak camera delivered	3	Oct-02	Oct-02
VISAR	100% design review complete	3	Oct-02	Oct-02
FABS-LRU	Deliver FABS LRUs to OAB	3	Nov-02	Oct-02
SXI	SXI-1 Offline acceptance tests Complete	3	Aug-02	Oct-02
FABS	FABS 100% Design Review	3	Sep-02	Nov-02
NY	Conceptual design review complete	3	Sep-02	Nov-02
DIM	3rd DIM Fabrication & Assembly (M4A)	3	Nov-02	Nov-02
SXD	2nd streak camera delivered	3	Dec-02	Dec-02
DIM	2nd DIM ready for use on NIF (M6)	3	Jan-03	Jan-03
SXI	SXI-1 1st Use on NIF (M6)	3	Jan-03	Jan-03
SXD	Off line acceptance tests complete	3	Jan-03	Jan-03
SXD	SXD-1 1st Use on NIF (M6)	3	Feb-03	Feb-03
DIM	3rd DIM ready for use on NIF (M6)	3	Feb-03	Feb-03
HENEX	Fab and assembly complete	3	Sep-02	Feb-03
FABS	FABS Fabrication complete	3	Dec-02	Feb-03
FABS	Off line acceptance tests complete	3	Mar-03	Feb-03
GXD	100% design review complete	3	Mar-03	Mar-03
FABS	FABS 1 First Use on NIF (M6)	3	Jul-03	Jul-03
VISAR	VISAR First use on NIF (M6)	3	Jul-03	Jul-03
HENEX	HENEX First use on NIF (M6)	3	Dec-03	Dec-03
GXD	GXD First use on NIF (M6)	3	Mar-04	Mar-04
NY	NY First use on NIF (M6)	3	Feb-06	Feb-06

Budget Report

Figure 1 summarizes the status of spending against the FY02 Budget Authority (BA) of $8857K. Commitment of funds is still lagging slightly behind plan due to late starts at some of the non-LLNL sites, as well as some late procurements that will be placed before the end of the FY. Figure 2 illustrates the same information for costs (Budget Outlay [BO]); the delay in placing some procurements will result in a reduction in BO projected relative to plan near the end of this FY. Some procurements have been deliberately delayed to meet a reduced cost goal for this FY due to underfunding of the NIF Director activities. The schedule impacts of procurement delays are accounted for in Table 1.

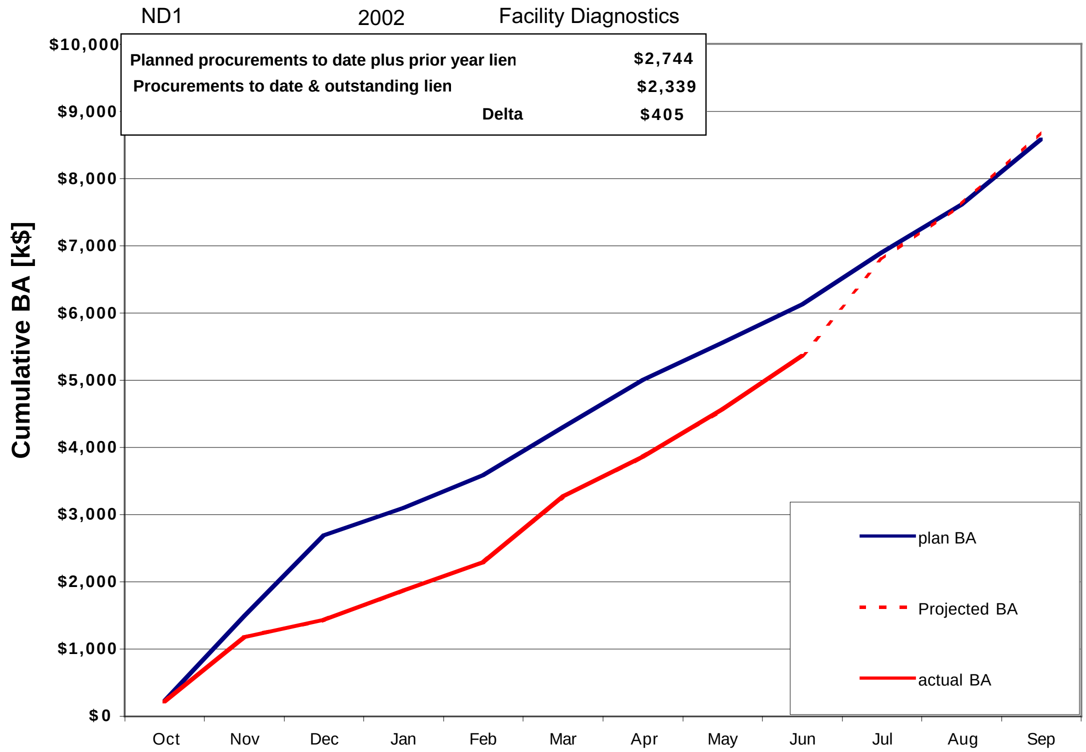


Figure 1. Status of commitment of resources (BA) against the FY02 plan for the Facility Diagnostics.

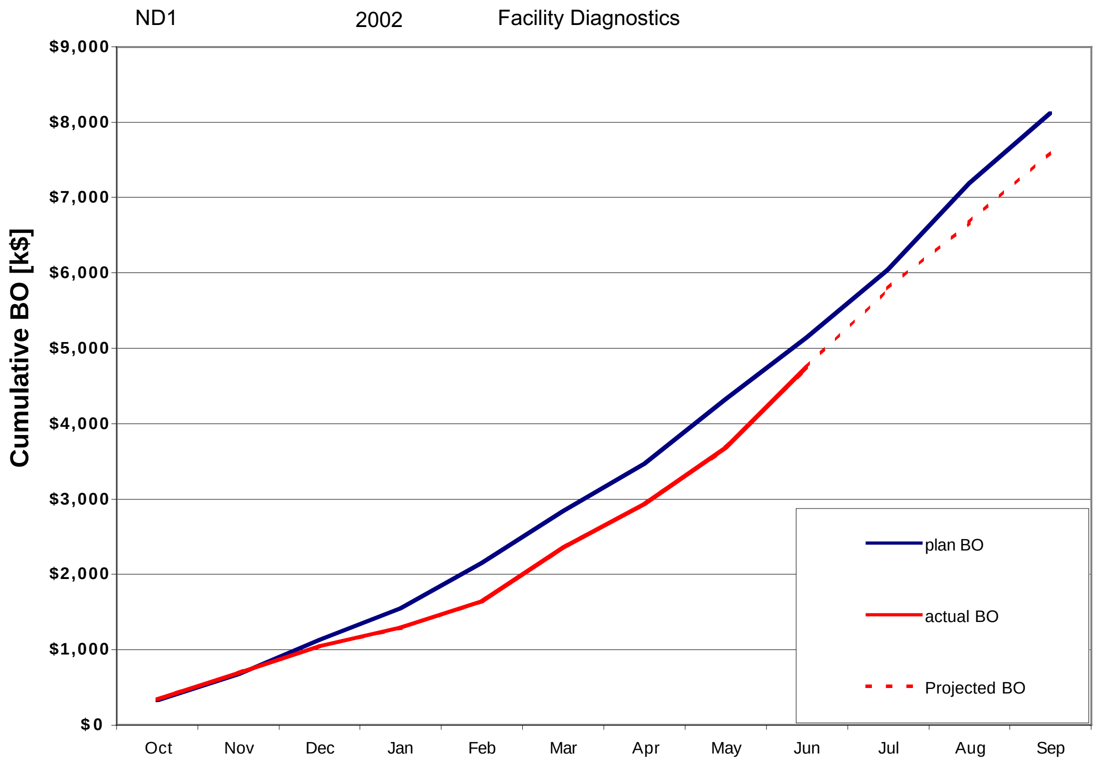


Figure 2. Status of costs (BO) against the FY02 plan for the Facility Diagnostics.

Change Control Board Actions

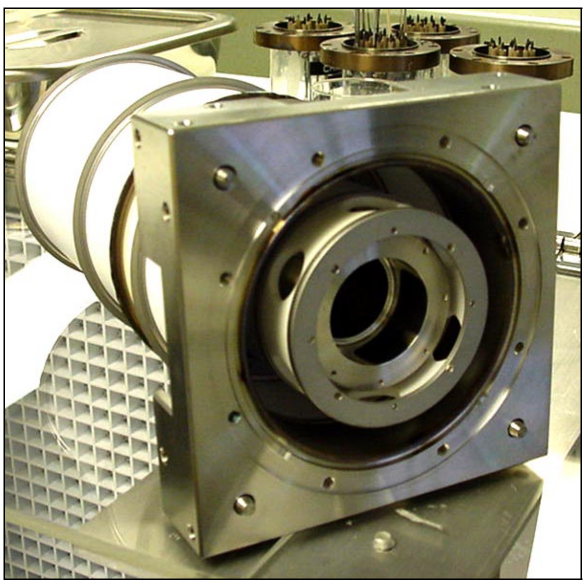
BSCR-006: Transferred $282K to the FABS-LRU Control Account Plan (CAP) to support increased design costs above estimates and for protection of the mirror supports system from scattered laser light.

BSCR-007: Transferred $146K to the SXI CAP to cover under-scoped electrical design.

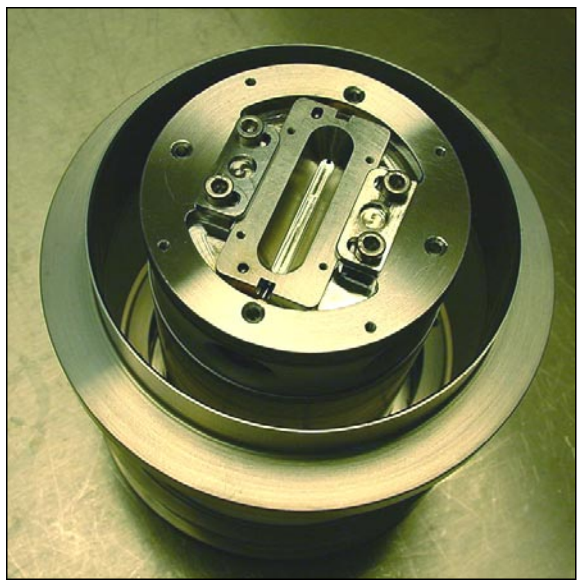
BSCR-008: Modified the schedule for the SXD to delay delivery of the first SXD until after 10/1/02 to reduce FY02 expenditures. Availability of the SXD on the target chamber was delayed until Feb 03, still consistent with the need date for the beam commissioning plan.

Streaked X-Ray Detector (SXD)

The 100% design review for the SXD was presented in May. There will be follow-up reviews of tube performance data from tests being performed by Hadland now (see Figure 3). Two air boxes were built and sent to DRS Hadland. The front flange and mounting assembly were also machined. Since the two designs for mounting the diagnostic to the DIM cart were approximately the same cost, the simpler design shown at 100% design review was selected, see Figure 4. The slow sweep of at least 60 seconds was implemented to enable flat fielding on the continuous Manson x-ray source. In addition, the 4ω fiber optic assembly is designed to be an easily replaceable item. An initial JAVA-based user interface was created to link to the Hadland command set.



(a)



(b)

Figure 3(a). Front end of streak tube and mounting flange for tests, (b) photocathode assembly to go into the front end of the streak tube.

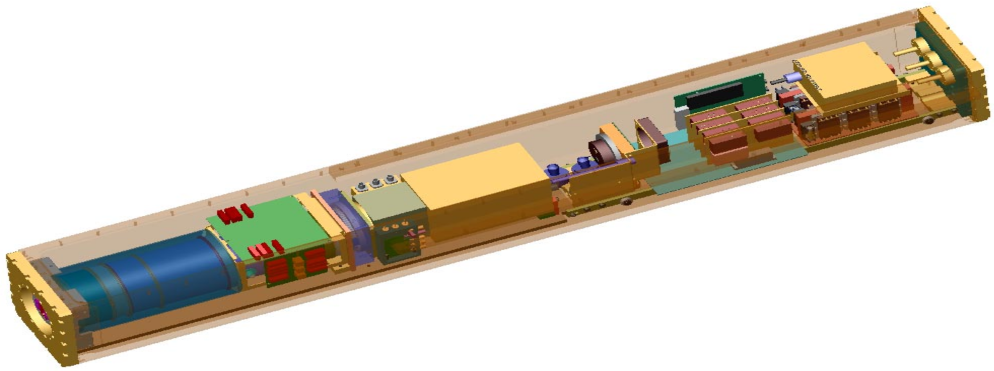


Figure 4. Computer-Aided Design (CAD) model of the DRS Hadland x-ray streak camera an in air box, from the 100% design review.

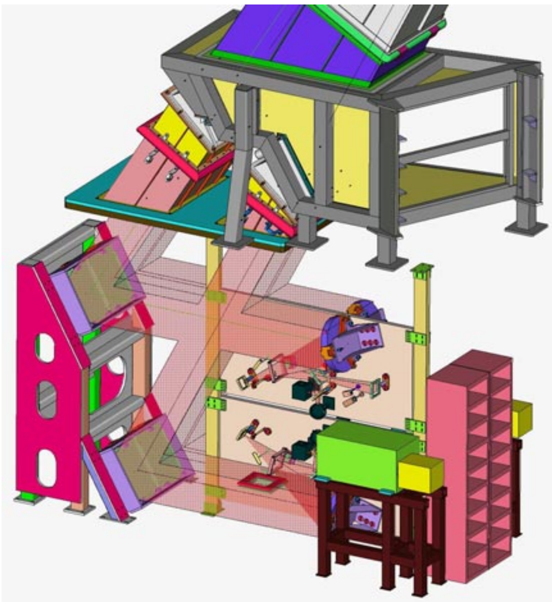
Static X-Ray Imager (SXI)

The last quarter marked the fabrication and procurement phase of the SXI. Ninety percent of the procurements have been received at LLNL. However, some manufacturing problems forced a delay in the vacuum housing, see Figure 5. Assembly of subassemblies is continuing as planned, so that the final (M6) delivery date will be maintained. Concerns about the long-term reliability of the rotary vacuum seal for the motor shaft has led us to redesign the vacuum seal. Details of the alignment laser are currently being designed into the diagnostic. Cables and switch assemblies are being fabricated in anticipation of electrical wiring tasks.

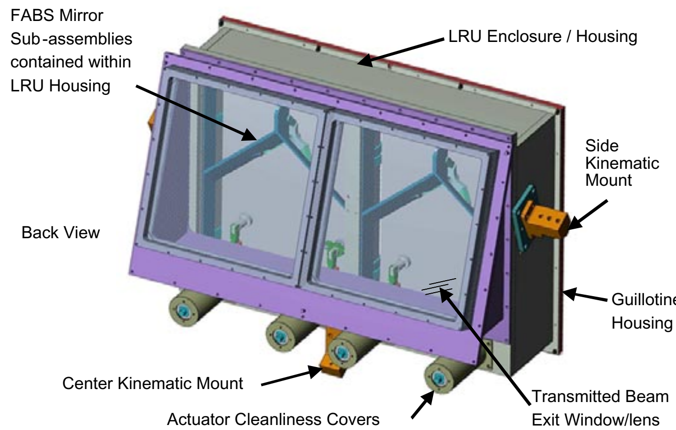
Figure 5. The vacuum housing for the SXI manipulator section being machined.

Full Aperture Backscatter Diagnostics (FABS)

The Full Aperture Backscatter (FABS) diagnostic is used to analyze scattered laser light originating from the NIF target chamber to characterize the energy coupling between the Laser and NIF Targets, see Figure 6(a). The FABS project made progress on several tasks during the last quarter. The beam tube and floor grating designs are near completion. These will need to be in place January 2003 when the first laser shots are planned. Mechanical models for the optical attenuator and calibration lamp were created. The software drivers for the integrating diode and fast diode measurements were completed.



(a)



(b)

Figure 6(a). CAD model of layout of FABS diagnostic in the basement of the target area, (b) CAD model of FABS LM8 mirror (LRU) assembly.

The FABS measurement requires a direct line of sight from the NIF target, through the final transport laser mirrors (LM8), and onto the diagnostic. The FABS line replaceable units (LRUs) have been specifically designed to support the LM8 mirrors [see Figure 6(b)], while providing the necessary line of sight and occluding less than 15% of the desired backscattered light. Since the mirrors are needed for commissioning the first NIF beamlines, the LRU part of the FABS has been on an accelerated schedule. During the Third Quarter of FY02, the FABS LRU team's accomplishments include:

- Awarded FABS LRU fabrication and procurement contract to Honeywell Federal Manufacturing and Technology in Kansas City, Missouri (HKC FM&T) on 4/30/02.
- Completed and inventoried 33% of FABS LRU components at HKC by 6/30/02.

In the Fourth Quarter, the FABS LRU team will have received 100% of all parts and components for the FABS LRUs from the subcontractor, HKC FM&T, and miscellaneous components ordered through LLNL. The team will be certifying the Optics Assembly Building (OAB) specialized hardware and workstation used to assemble the FABS LRU. The team will also be addressing final interface issues with (1) the motor Controls Group for Mirror Alignment, (2) the

Transport and Handling Group responsible for moving and installing the LRU into its final position, and (3) the Beampath Infrastructure System (BIS) regarding the final connection of the FABS LRUs to their environmental beam tubes. Finally, the team will have originated the final Safety Notes and DRAFT Assembly and Installation Procedures.

Final assembly and installation of the FABS LRUs onto NIF will take place in the First Quarter of FY03 (November 15, 2002).

Diagnostic Instrument Manipulator (DIM) Positioner System (DPS)

The vendor has made significant progress on the fabrication and assembly of two DIMs (the second [see Figure 7] and third to be installed on the chamber). The vacuum housing for the second DIM has been leak checked and is ready for rail alignment. All components for these assemblies have been fabricated or procured. The gate valves and gimbals have been received at LLNL and are ready for final assembly. The top port cover needed for installation of the polar DIM on the target chamber is in procurement and on schedule for delivery in August (see Figure 8). The first article DIM is awaiting modifications to the ballscrew mechanism and rotary shaft seal. It will be installed on the target chamber at the equator level in November.

Figure 7. Second DIM undergoing assembly at the vendor. This DIM will be mounted vertically on the pole of the target chamber and will accommodate multiple diagnostics including the VISAR interferometer.

Figure 8. NIF target chamber top port cover on which the polar DIM will be mounted.

Gated X-Ray Detector (GXD)

On April 23, 2002, LANL presented the Conceptual Design Review for the GXD (see Figure 9). Questions were recorded, and there were 2 type 1 comments, 36 type 2 comments, and 40 type 3 comments. The design team's responses to all comments were accepted by the review committee, and the Conceptual Design Review was formally accepted May 30, 2002. The LANL design team members now have accounts on the LIAM computer information system that contains important mechanical interface drawings and other valuable NIF information. In preparation for the 65% review, several issues have surfaced concerning the GXD specifications. A joint meeting will be held soon between the detector expert working group and the GXD design team to resolve some of these technical issues.

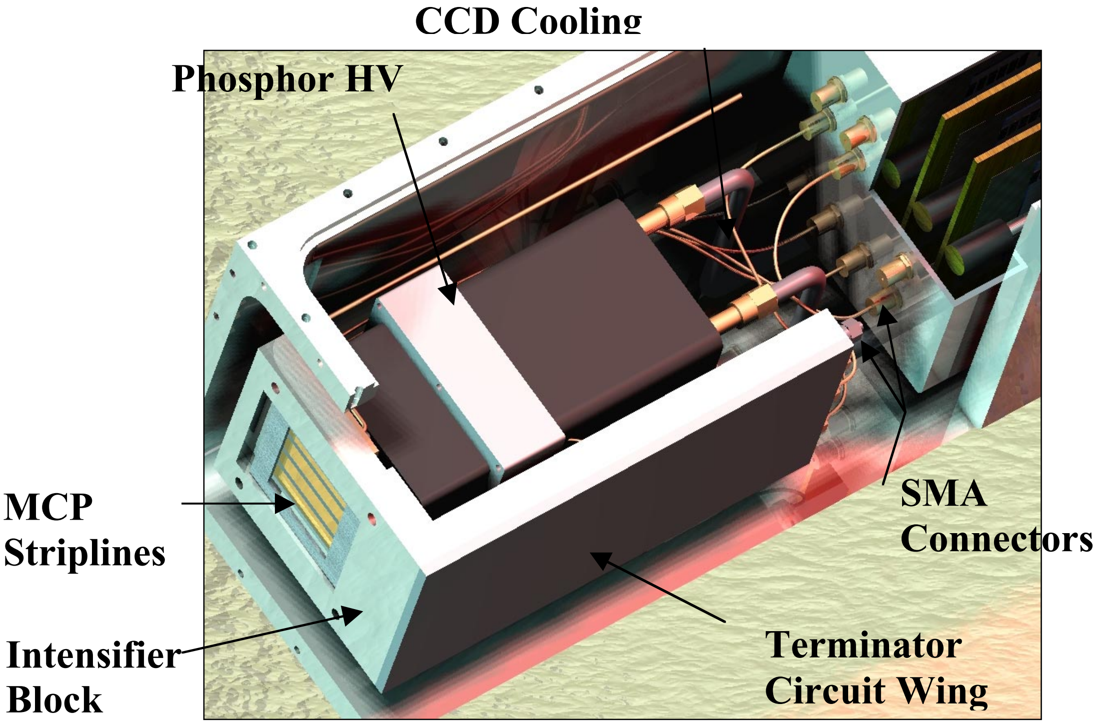


Figure 9. CAD model of microchannel plate detector module in front of GXD air box.

X-Ray Survey Spectrometer (HENEX)

The contracts for the fabrication of the HENEX mechanical components were awarded in May. This includes the three crystal modules, five CMOS detector modules, electronics box, battery enclosure, and nosecone. The assembly and testing of the mechanical components will begin in August (see Figure 10). The NIF interface, protocols, and software issues were clarified during a visit to NRL by Perry Bell and Albert Lee on May 29. The HENEX computer control system and software are nearing completion. The project is on track for deployment at the University of Rochester's Laboratory for Laser Enrgetics in March 2003 and at NIF in December 2003.

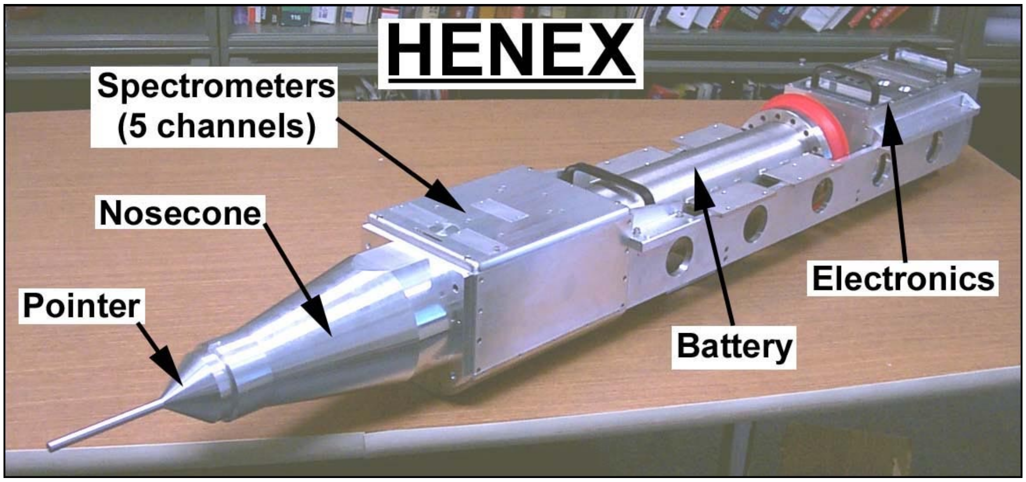


Figure 10. Mechanical hardware of HENEX being readied for testing at Omega.

VISAR

The line-imaging Velocity Interferometer (VISAR) design continued on schedule through the third quarter of FY02. Milestones included presenting the M1 Conceptual Design Review and initiating probe laser procurement. The team made significant progress on design work for the Engineering 65% Design Review, scheduled for late August.

The NIF VISAR CDR was presented on June 14; the documents are available on the LIAM server. In addition to the required deliverables, the team presented preliminary design of major system components for the NEL VISAR version. The presentation included initial interferometer design, controls systems for data collection and alignment, probe laser requirements and procurement progress, optomechanical design concepts for actuated lens and mirror mounts, the proposed fiber delivery method, and an overall system concept. The VISAR optical relay design is one of the system's more complex elements (see Figure 11). It requires roughly 150 feet of enclosed and protected image relay from the polar DIM through the facility to the 50' mezzanine, where dual Mach-Zender interferometers and streak cameras for data collection will be fielded. The optical relay must have remote, automated alignment capability. The optical relay design constraints include the ability to image 1- to 10-mm-diameter objects, f/3 diffraction-limited light collection at 659.5 nm, and a spatial resolution of 0.2% of field of view. For the polar DIM location, significant design work for image relay optics and positioning hardware was completed in the third quarter of FY02. A mature optical relay design was presented at the CDR, and the design team will present a completed optical design at the Engineering 65% review. The larger optics will have a long procurement cycle that may impact the overall schedule if not ordered shortly after the 65% review.

Design between the CDR and 65% review focuses on completing the aforementioned optical relay design and the optomechanical CAD design solids. Ongoing optomechanical design concentrates on lens and mirror mounts, optical relay transport tube and lens enclosure box, lens envelope definition, interferometer hardware, mounting structures for the back of the DIM, and DIM cart and extension tube.

Another important task for the third quarter was initiating probe laser procurement. In April, Bechtel Nevada specified a 659.5-nm, 60-kW, single 1.2-µs flat-pulsed laser to be bought by LLNL for the NEL VISAR. Because this laser is a long-lead item, procurement had to be initiated as quickly as possible. LLNL procurement prepared an RFQ for the laser, worked with Bechtel Nevada to identify potential vendors, and devised a staged approach to expedite the process. The current procurement schedule indicates that the laser will be delivered to Bechtel Nevada/Los Alamos Office in late January or early February 2003.

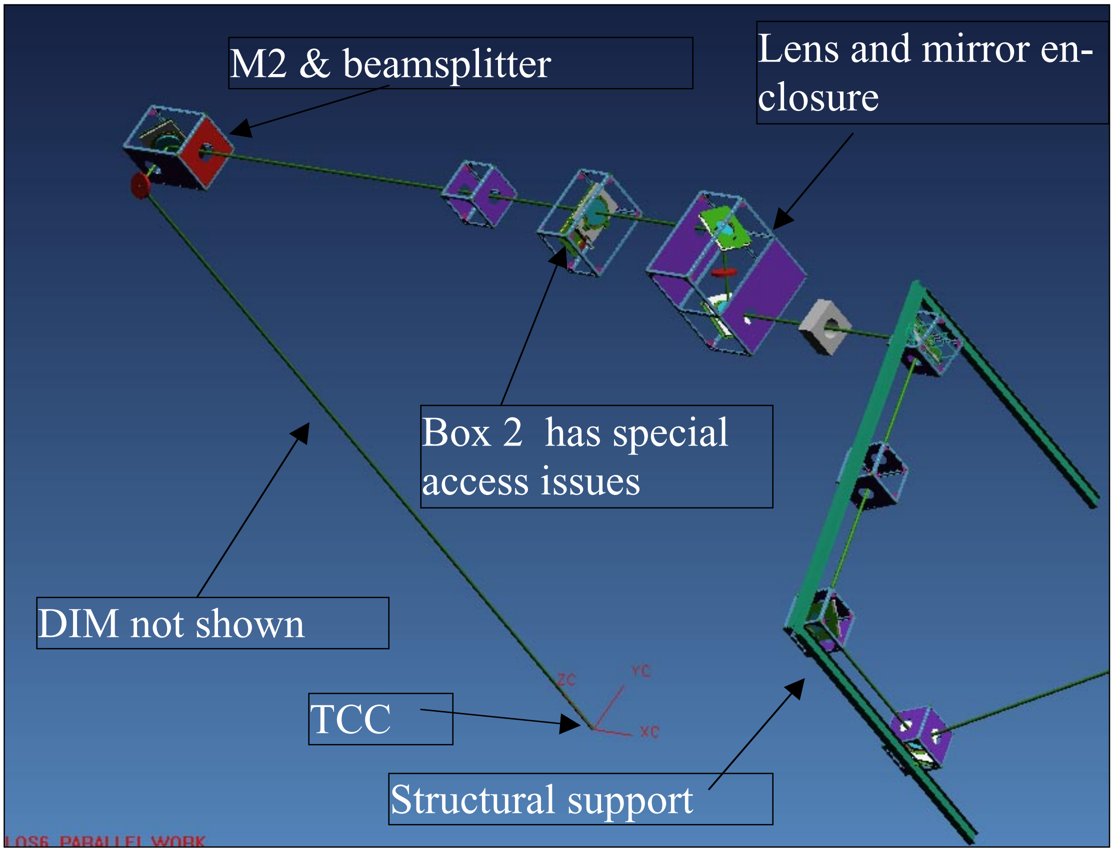


Figure 11. Conceptual layout of VISAR optical beampath from target (TCC) through the polar DIM, across the target bay ceiling, to the interferometer located above the Switchyard 2 diagnostic mezzanine. Current design work includes the beam tubes and lens enclosure boxes. This work must be closely coordinated with the planned installation of main laser beampath infrastructure and utilities in this area.

Neutron Yield Diagnostic (NYD)

The requirements document was reviewed with the Nuclear Diagnostics Expert Group at the Madison meeting, and agreement was reached on the final form for the requirements, if not on all the details. SNL will now take responsibility for finalizing the details by the end of August. However, due to the delay in finalizing the requirements, a delay of two months has been requested for the CDR, to mid-November. A formal change request was filed with the NNDP for four port locations that best meet the physics requirements of the diagnostic. Significant progress was made on two major engineering issues. (1) Commercial pneumatic transport systems vendors were consulted on requirements for the four rabbit transport lines, and most of the desired features can be accommodated. (2) Four conceptual designs for transport tube retraction were considered, and a best candidate was selected.

Target Diagnostic Alignment (TDA)

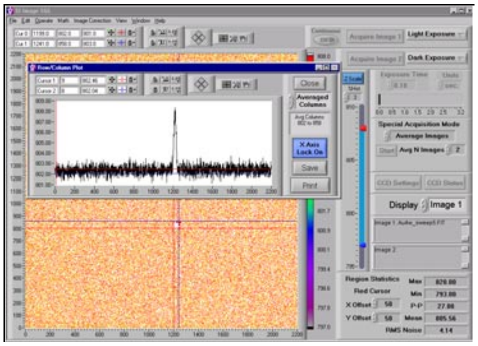
The CDR for the opposed port alignment system (OPAS) for DIM base diagnostics has been completed and accepted. The design drawings have been prepared and approved on the Product Data Management System per NIF configuration control policies. Testing has been completed on the telescope (see Figure 12), and near-diffraction-limited images were obtained with 34-μm image resolution. NIF facility integration is a concern. Electrical design support is required for control rack design, cable identification, and NEMA can interface.

The laser pointer alignment system (LPAS) for SXI requirements document has been written. The LPAS will be used with the Target Alignment System (TAS) imaging system for SXI alignment. The CDR and detailed design will be completed next quarter. Modifications to the SXI for the LPAS are required prior to SXI assembly, scheduled to start on August 15, 2002.

Figure 12. OPAS High Magnification Telescope.

Diagnostic Timing Fiducial

Characterization tests have been conducted in the B391 laser laboratory to establish the minimum fiducial 4ω energy required at the photo cathode for the SXD diagnostic. The tests were conducted utilizing an older, rebuilt SXD. A commercial “Jaguar” laser system is used to generate the short optical pulses at 266 nm, and a 400-micron core UV-grade fiber transports the pulses to the diagnostic. Measurement results to date indicate that energy of ≥5 nanojoules is required to get an adequate count on the CCD (see Figure 13). However, the repeatability of the energy measurements has been difficult due to issues with the aging diagnostic.



- Example of 4ω fiducial pulse taken on a test camera using the Jaguar Laser System.
- Gold photo cathode.
- ~5 nJ at the photo cathode (400-μm transport fiber with non-optimized spot).
- 5-ns sweep.
- ~70-ps FWHM @ 266 nm.

Figure 13. 4ω fiducial pulse taken on a test camera using the Jaguar Laser System.

Preliminary manufacturing costs have been received from a fiber vender for custom 2ω/4ω photonic crystal fiber designs based on the submitted specifications. The initial design would be a pure silica core optimized for 532-nm operation. Future designs may utilize an air core to reduce losses and non-linear effects for 266-nm operation.

Preliminary radiation measurements have been made on a commercial UV grade, step index fiber at 4ω. The fiber is the baseline design for the new Hadland Camera. The data indicates a high susceptibility to damage.

Due to the high 4ω energy required at the DIM for the SXD diagnostic, along with the transport fiber insertion loss estimates, the distance from the laser source to the DIM may have to be ≤20 meters. Multiple laser systems may be required to service all DIM locations around the chamber. The alternative would be a roving laser system to service the required DIMs only.

Next quarter, fiducial test at 4ω will be conducted on the new Hadland camera to verify the energy requirement. Also testing of Cs-coated, n-type, GaAs, PMT photocathodes at 2ω will be conducted on the old camera. Based on those measurements, the laser system and transport conceptual design can be completed. Several different architectures are under consideration.

Radiation tests on more samples of commercial UV fiber will also be conducted to identify the optimum design. The samples tested had dopants in the cladding region. New samples will be pure silica.

A Purchase Order will be released for the first round of fiber pulls for several photonic crystal fibers for the fiducial transport fiber design by mid-September 2002.

Target Diagnostic Integration

Diagnostic Integration works with the diagnostic designers to adapt the facility to meet their needs and help them integrate their diagnostics into the facility. There is a continuous interaction between the Integration Engineer and the NIF Project through the BIS organization, the Architecture and Engineering firm, various Integrated Product Team leaders, and project management to make cost effective decisions.

VISAR and Polar DIM

Diagnostic Integration worked with Parsons Engineering to complete the design for hardware associated with the operation of the polar DIM. This includes a new rotunda crane for diagnostic installation and platform steel at two new levels, one to access the aft end of the DIM and the other for crane maintenance. This is shown in Figure 14.

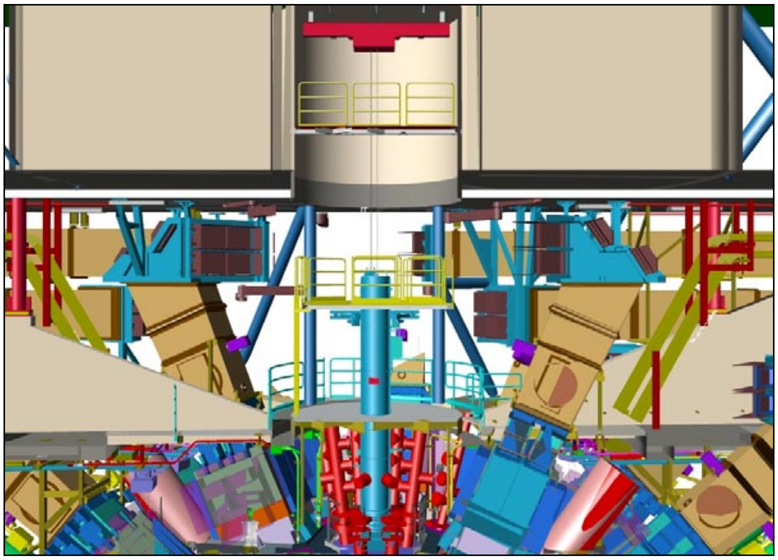


Figure 14. CAD model of Polar DIM rotunda cranes for diagnostic installation.

The goal was to finish the design and buy the steel this fiscal year for the construction to begin in FY03. This work is being coordinated with the contractor, Jacobs Engineering, along with the DIM and upper mirror frame installation. The polar DIM is currently scheduled to be installed in the December–January time frame. It is important that the DIM be installed before all of the mirror frames are in place.

The VISAR line of sight to Switchyard 2 was finalized. A path to Switchyard 1 that would also work was evaluated as well. However, due to the construction activity in Switchyard 1 scheduled for FY03, it was decided to stay with Switchyard 2. Stay-out zones are being set up in the 3D model in Switchyards 1 and 2 for future VISAR and, possibly, Thomson scattering experiments.

SXI

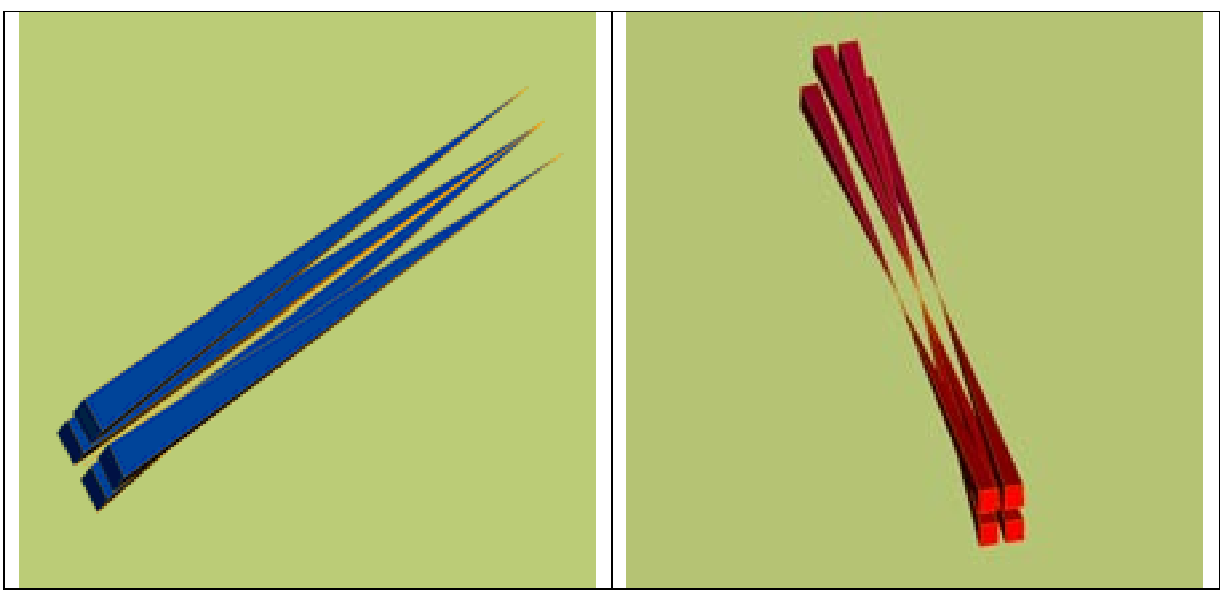
The building had to be modified to accommodate the new SXI locations. The SXI were moved to avoid interferences with the Final Optics Systems. The designs for the facility modification for both the upper and lower SXI were completed by Parsons Engineering. Figure 15 shows the target chamber pedestal that had to be scalloped to make room for the SXI.

Figure 15. CAD model of the target chamber pedestal redesigned to accommodate the SXI.

There were other interferences with support steel framing that was redesigned prior to installation. This rework is now integrated with Jacobs work in the target bay.

Chamber Interference

The Diagnostic Integration team is creating laser beam models in PRO/E that include 1, 2, and 3ω light that can be pointed and defocused to look for material that may be in the path of the unconverted and converted light. This work is in process. The intent is that a spreadsheet will be prepared in the experimental shot setup and uploaded into PRO/E to check for interferences. Figures 16(a) and (b) show 1 and 3ω beams.



(a) *(b)*

Figure 16(a). 3ω beams shown pointing away from target chamber center and (b) 1ω beams shown going through focus.

Three-dimensional (3D) modeling for the diagnostics is also part of this working group's effort as shown in Figure 17.

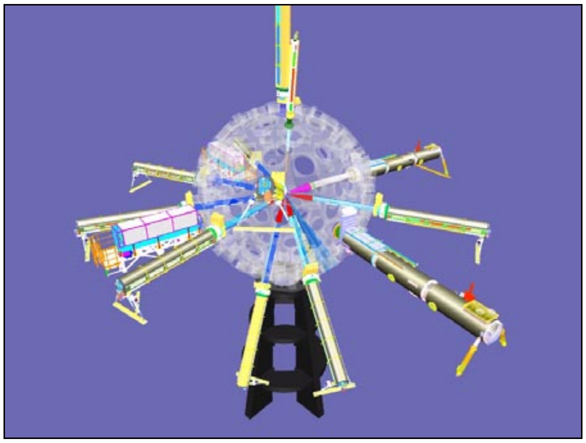


Figure 17. Example of a 3D model of target chamber diagnostics.

Target Chamber Port Allocation

One important issue being addressed is the allocation of the target chamber ports. Decisions now may preclude future options. Several ports are not useful for large diagnostics, i.e., DIM-based diagnostics, due to lack of available space, seismic restraints, Final Optic Assembly (FOA) stay-out zones, utilities, and supporting framework.

- SXI, VISAR and FABS (NBI) ports have already changed from the baseline designation.
- PSBO, NY, TAVS, FFLEX, Thomson scattering are requesting port changes from the original baseline designation.

The newly established working group chaired by John Celeste will evaluate requests and make recommendations to the NNDP Program Manager and Target Chamber Integrated Product Team Leader.

Controls Integration

The Diagnostic Controls Integration Team (DCIT) has grown to six full-time and four part-time members. Additional (two full-time and one part-time) members are scheduled to join in September. DCIT provides services to the NIF Project, NNDP, and ICF and are responsible for the integration of Target Diagnostics (TD) into the NIF in the following areas: electrical utilities and infrastructure, controls design, data acquisition, data analysis, data archival, and software development.

The latest accomplishments in NNDP are as follows:

- Completed SXI diagnostic controller (DC) software.
- Spun off front-end processor (FEP) & DC emulator, generic diagnostic controller (GDC) framework software from the SXI code.
- Initiated SXD DC software using the GDC framework.

- Conducted a Framework Conceptual Design Review.
- Released the DCP (FEP & DC) emulator for use.
- Evaluated our ability to integrate the Hamamatsu streaking camera into a diagnostic.
- Competed the following JAVA accessible object libraries:
  - Spectral Instrument 800 series camera object library
  - National Instrument FieldPoint object library
  - Heidenhaim encoder object library
  - Integrating diode (FABS) object library
  - GPIB object library
  - Tektronix 694 object library

DCIT has begun the following tasks:

- Preparing test plans and procedures for the SXI and SXD diagnostics.
- Finishing SXD DC software (see Figure 18).
- Integrating SXI hardware with software.
- Initiating development of DIM Utilities Controller requirement and design.
- Initiating development of Cross Timing Controller software.
- Initiating development of FABS DC software
- Initiating development of an Embedded Controller for the Spectral Instrument 1000 series CCD camera and GXD.
- Preparing plans for the implementation of the data analysis tools library and data archival system.
- Initiating VISAR cable plant design.

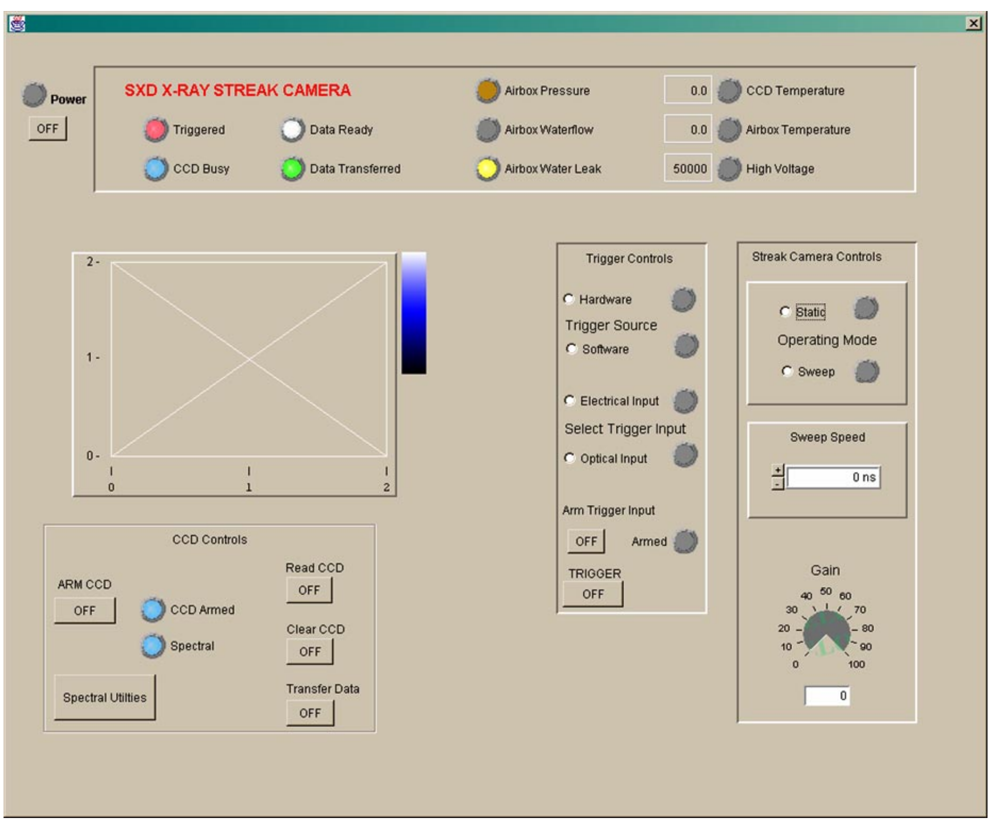


Figure 18. Proposed SXD Operation graphical user interface (GUI).

For the NIF Project-funded efforts, DCIT has:

- Provided assistance for the NEL2 release of theTD Supervisor and FEP software.
  - Support for the current DCP with multiple DCs
  - Minimal GUI to support manual selection of actions
  - Developed and tested with the DC Emulator
  - NEL3 release will provide shot control support
- Initiated the testing of the NEL2 TD Supervisor and FEP software.
- Initiated implementation of diagnostic controls offline test station.
  - Located in B391 in the optics lab and Target Positioner area
  - Includes network and timing connections to the ICCS test stand in B490
- Installed Target Chamber Ground Fault Monitor.
  - Drives 1 KHz into the chamber structure
  - Measures current on ground path
  - Compares measurement with a known baseline
  - Alarms to indicate potential fault condition
- Monitored and negotiated Target Area installation schedule.
- Developing methods to secure classified cable trays and seeking concurrence from LLNL Security organization and DOE managers.